



Alternative Emission Trading Mechanisms

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Canada and Kyoto

■ Kyoto Protocol

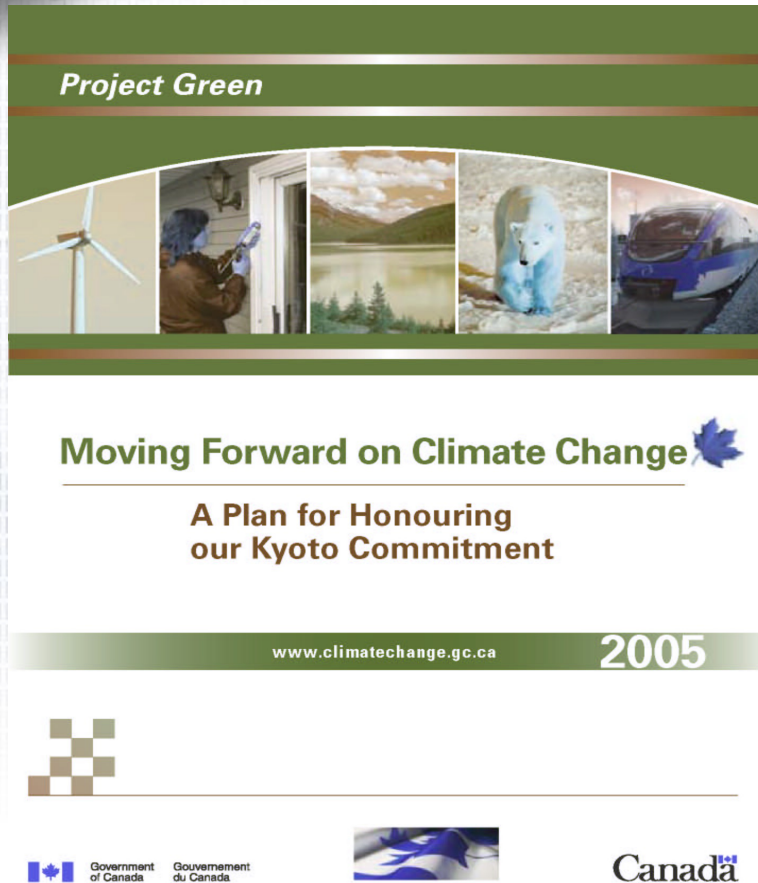
- Reduce GHG emissions of signatories by about 5% from 1990
- First Compliance Period: 2008-2012
- ratified by Canada 2002
- In force 2005

■ **Assigned emissions: 560 Mt CO₂ equivalent /a**

■ **BAU projection: > 810 Mt/a**

■ **Required Reductions: > 250 Mt/a**

Moving Forward on Climate Change



- Plan developed in consultation with provinces and industry
- Five Key Components
- Two involve emissions trading
 - Climate Fund
 - Large Final Emitter (LFE) System



The Climate Fund and Offsets

■ The Climate Fund

- Will purchase domestic and international emissions reductions
- Reductions certified by emission reduction credits (offsets)
- 75 to 115 Mt/a at cost of 4 to 5 G\$

■ Offsets

- Proponent specifies baseline emissions
- Credits generated = baseline emissions minus actual emissions
- Baseline often linked to output
 - Baseline = emission intensity target x output



Large Final Emitters (LFEs)

- **About 700 large emitters in manufacturing, mining, oil, gas and thermal electricity sectors**
- **Emission intensity targets**
- **Baseline Emissions = target x output**
- **Firms emitting below baseline generate credits**
- **Emissions above baseline require credits or offsets**



Approaches to Emissions Trading

■ **Baseline-and-Credit (B&C)**

- Output-linked Baselines
- Only emissions above baseline require credits
- Reductions realized before credits registered

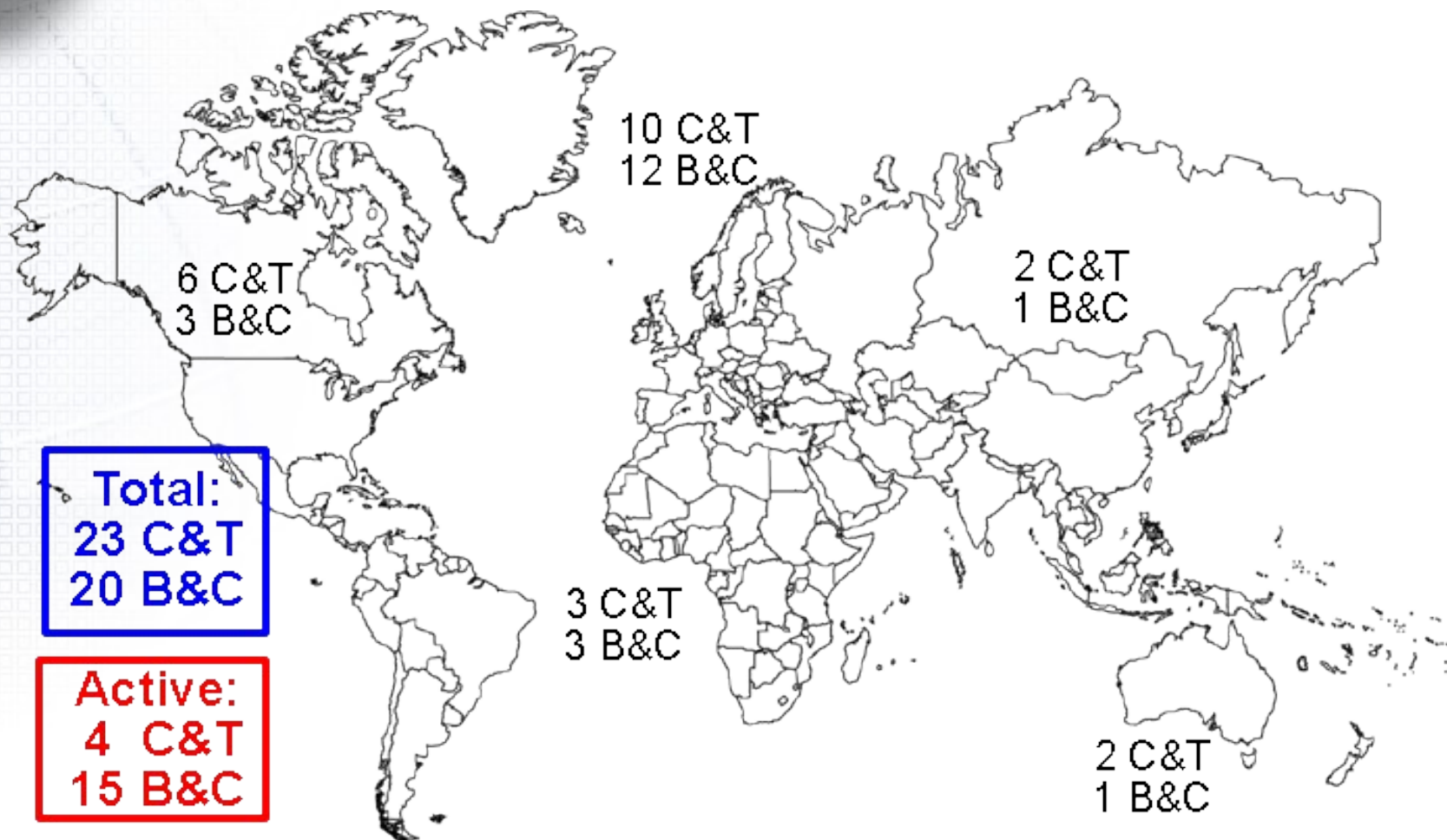
■ **Cap-and-Trade (C&T)**

- Aggregate cap (usually fixed)
- Permits allocated to firms
- All emissions to be covered by permits
- Excess Permits can be banked or sold
- Emissions greater than allocation must be covered by permit purchases



GHG Permit Trading Schemes (Active/Planned/Proposed/Suspended)

Source: Hasselknippe (2003)

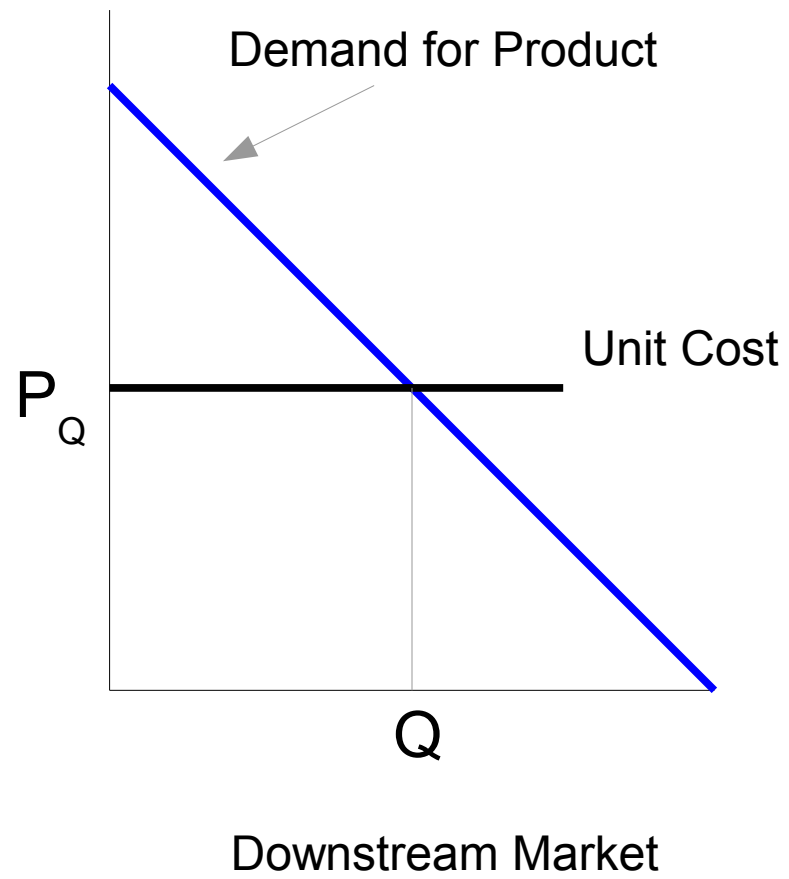
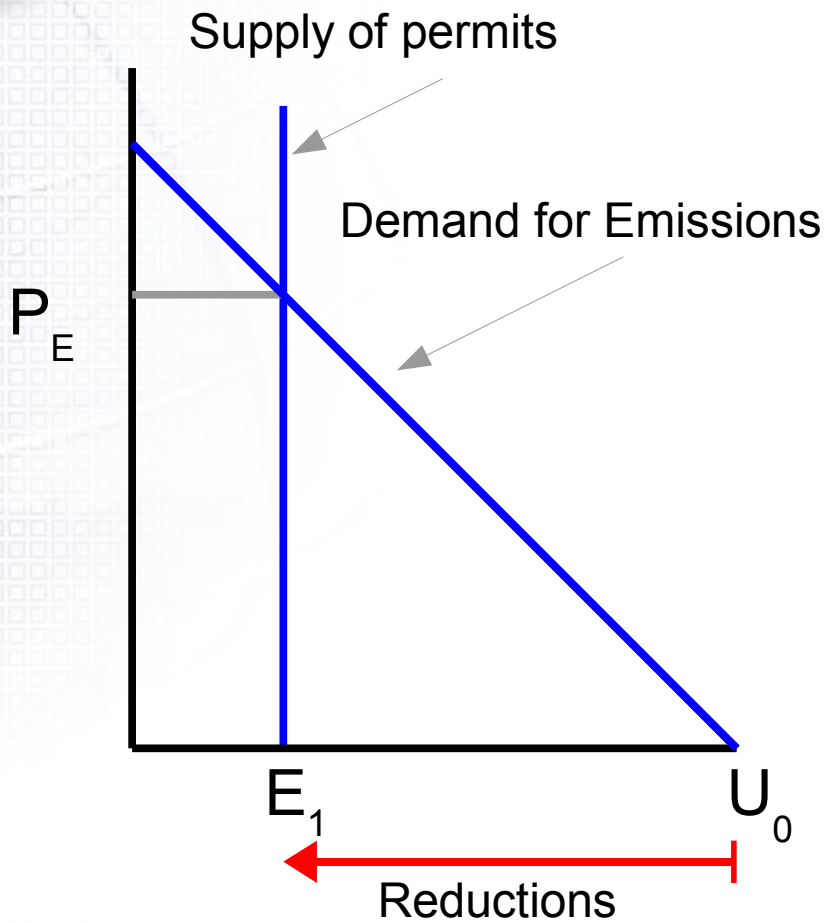




Competitive Equilibrium Analysis of Alternative Trading Mechanisms

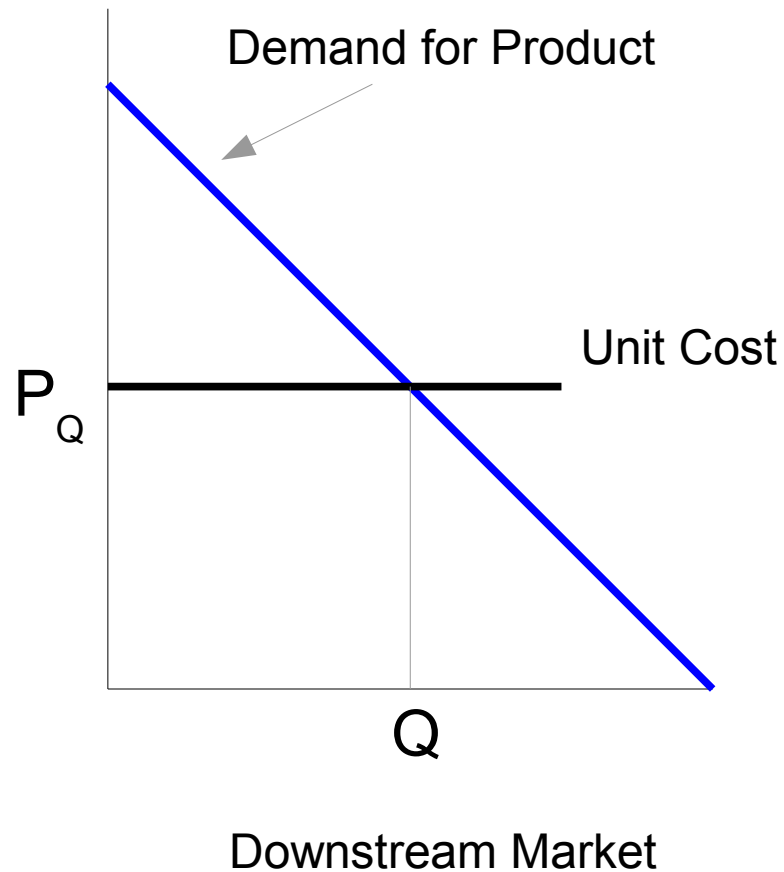
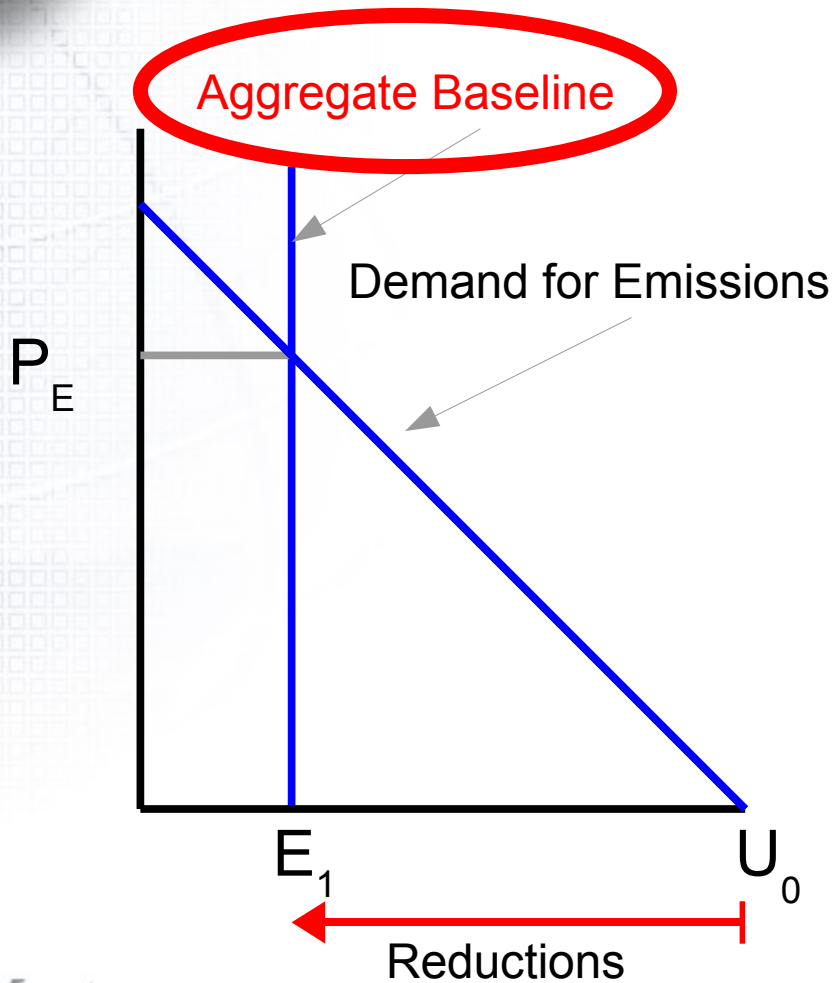


Cap and Trade



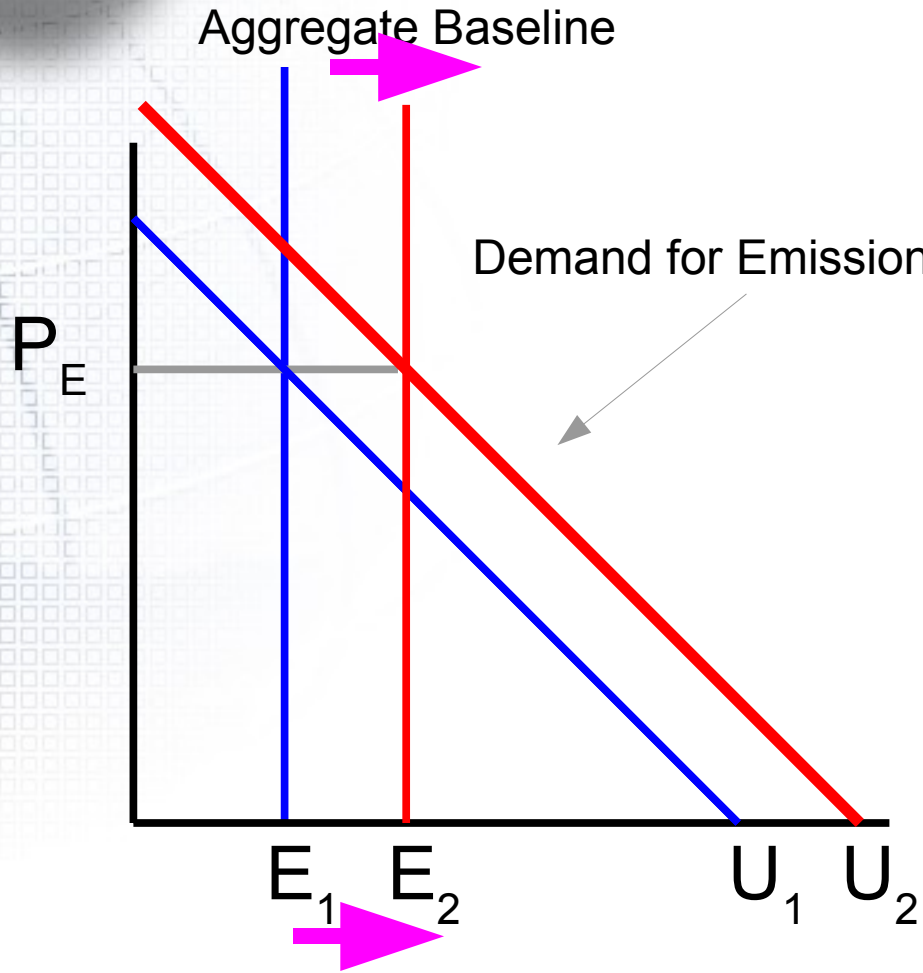


Fixed Baseline-and-Credit

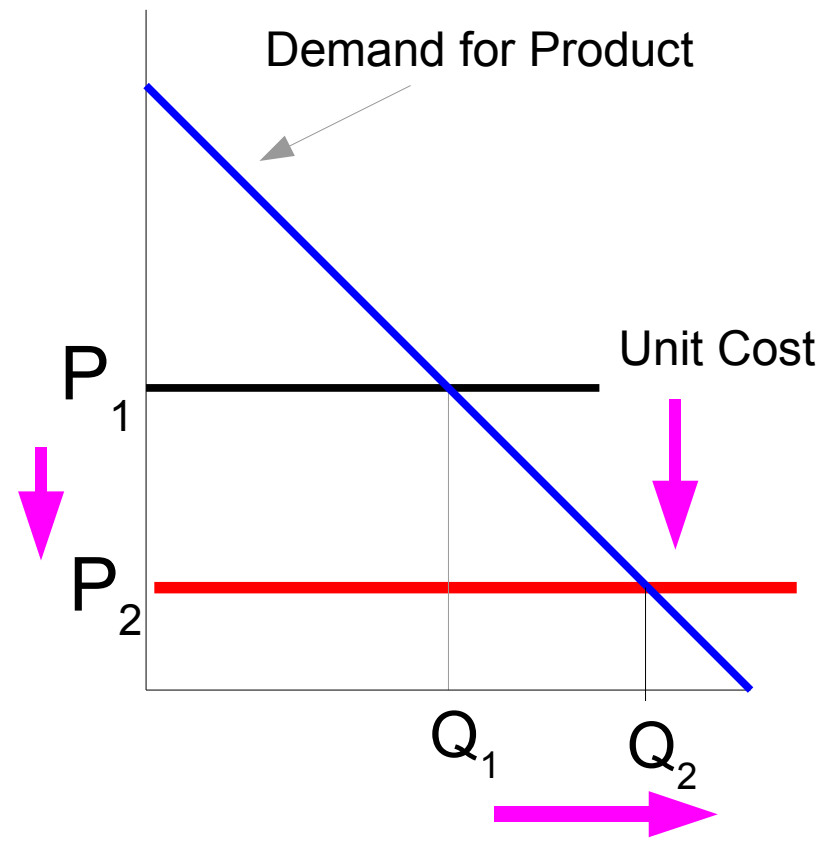




Output-linked Baseline



Emissions Market



Downstream Market



Simple Theory Suggests

**Output-linked baselines
are a poor way to achieve
a fixed emissions target!**



Laboratory Experiments Can

- **demonstrate predictions hold in controlled environment**
- **raise confidence in theory**



Laboratory Environment

- **Subjects represent firms**
- **Choose emission intensity and productive capacity**
- **Markets for Emission Rights and Output**
- **Full accounting framework**
- **Capacity adjusts slowly in response to profit signals**



Software Interface

Allowance Order Form

Please enter your bid/ask schedule:

You have dollars cash,
 allowances in inventory,
and a capacity of .

Bids:

At \$ I will buy units,
at \$ I will buy units more,
at \$ I will buy units more.

I will buy a maximum of units.
Costing a MAXIMUM of dollars.

Asks:

At \$ I will sell units,
at \$ I will sell units more,
at \$ I will sell units more.

I will sell a maximum of units.

DataView Window

Planner | Cost Table | IncomeStatement

Cost Calculator Panel

Capacity:
Emission rate:
Total fixed cost:

If I sell units of output
and if each allowance is worth
then I will emit tons of pollution,
and I must redeem allowances.

EACH unit of output will cost
 dollars for allowances,
 dollars in average fixed cost.

My overall average cost per unit of output is
 dollars.

Cash Panel

Current cash:

Allowance Market Panel

Allowance price last period:
Market volume last period:
Allowances you sold last period:
Allowance price this period:
Market volume this period:
Allowances you bought this period:
Current allowances inventory:
Allowance endowment per period:

Output Market Panel

Output price last period:
Market volume last period:
Output you sold last period:
Output price this period:
Market volume this period:
Output you sold this period:

Capacity and ER Panel

Last period's capacity:
Last period's emission rate:
This period's capacity:
This period's emission rate:
Total fixed cost:

Subject 1 Period 1

Please make your allowance market order

Subject: 1	Period: 1	Capacity: 4	Emission Rate: -	Cash: 5000.00	Allowances: 20	Cumulative Payoff: \$0.00 lab dollars
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Buying and Selling Emission Permits

Cost and Market Information



Experimental Design

Number of Sessions

<i>Treatment</i>	<i>C&T</i>	<i>B&C</i>
Fixed Capacity, Variable Emission Intensity	3	3
Variable Capacity, Fixed Intensity	3	3
Both Variable	3	3



Variable Intensity, Fixed Capacity

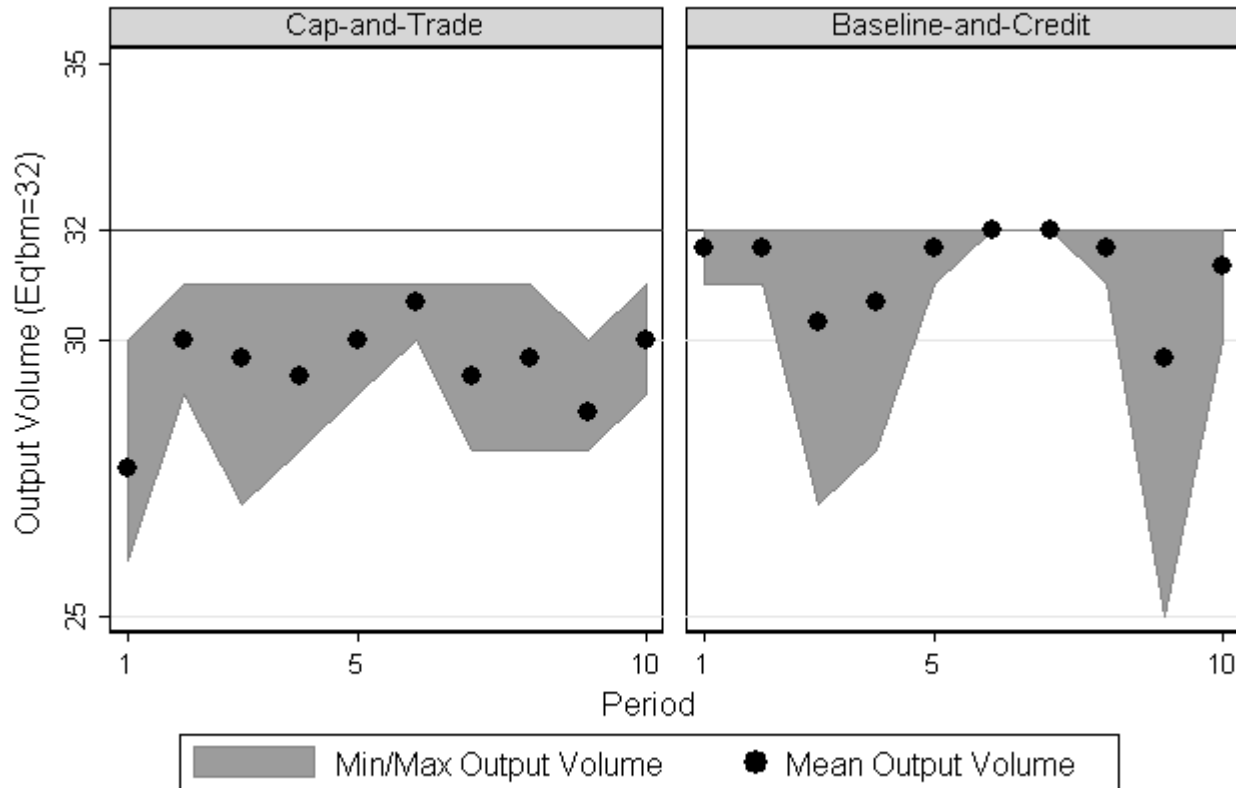
Baseline Experiment:

**Are the systems equivalent
when theory suggests
they should be?**



Variable Intensity, Fixed Capacity

as predicted
C&T output = B&C Output

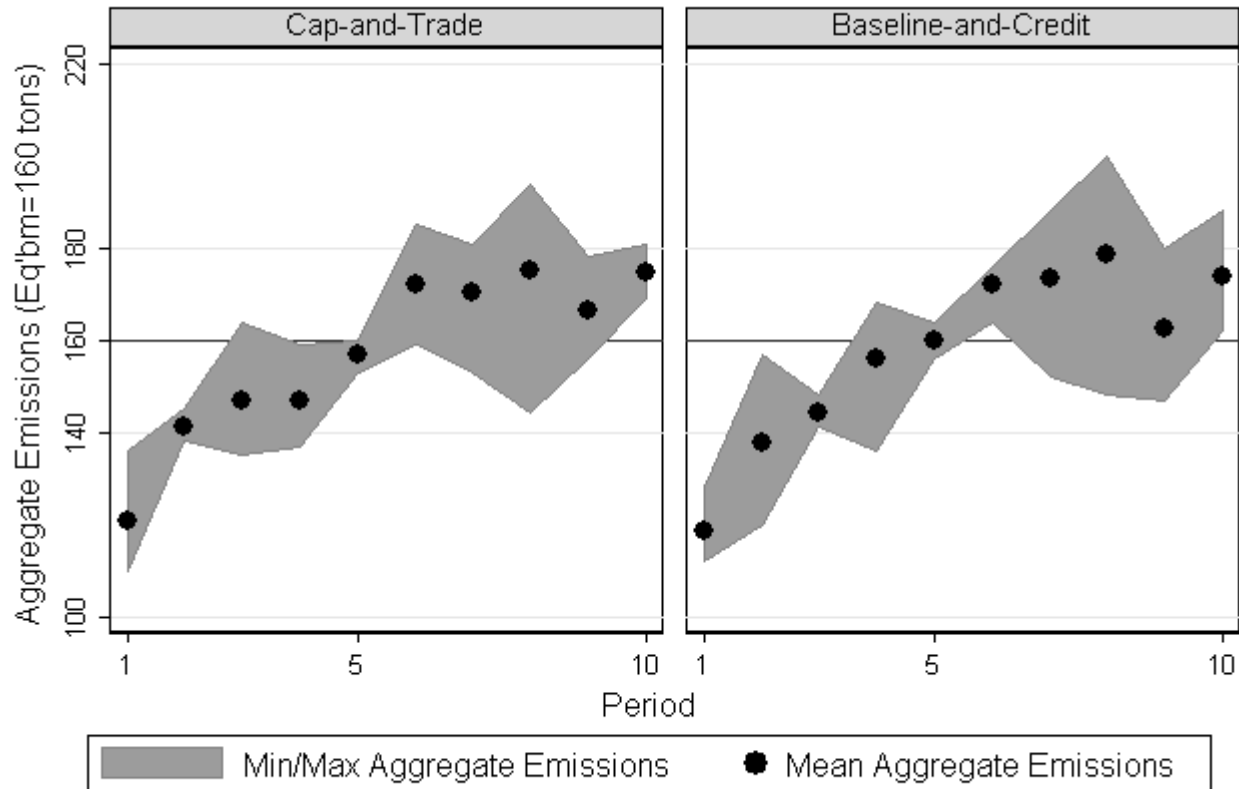


Graphs by Emission Trading Mechanism



Variable Intensity, Fixed Capacity

as predicted
C&T Emissions = B&C emissions

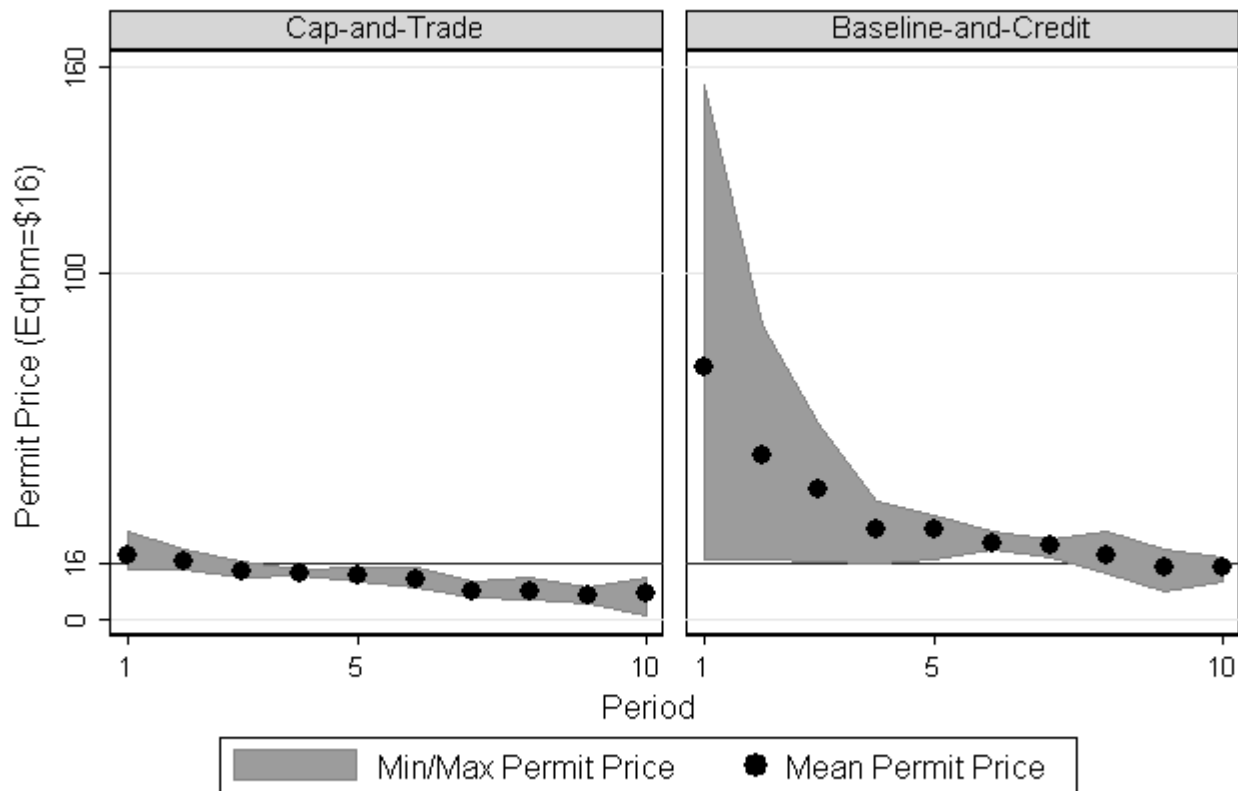


Graphs by Emission Trading Mechanism



Variable Intensity, Fixed Capacity

Permit Prices Evolve Differently

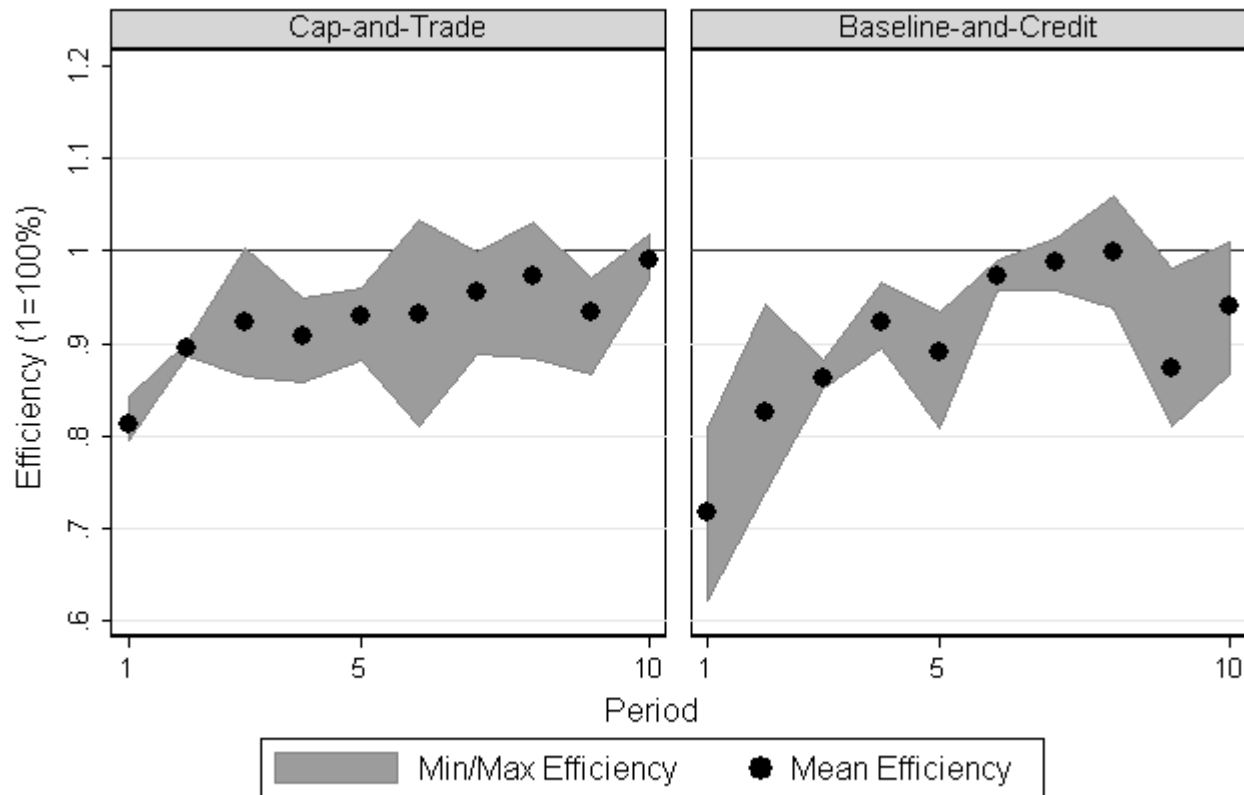


Graphs by Emission Trading Mechanism



Variable Intensity, Fixed Capacity

Efficiencies are comparable



Graphs by Emission Trading Mechanism



Variable Capacity, Fixed Intensity

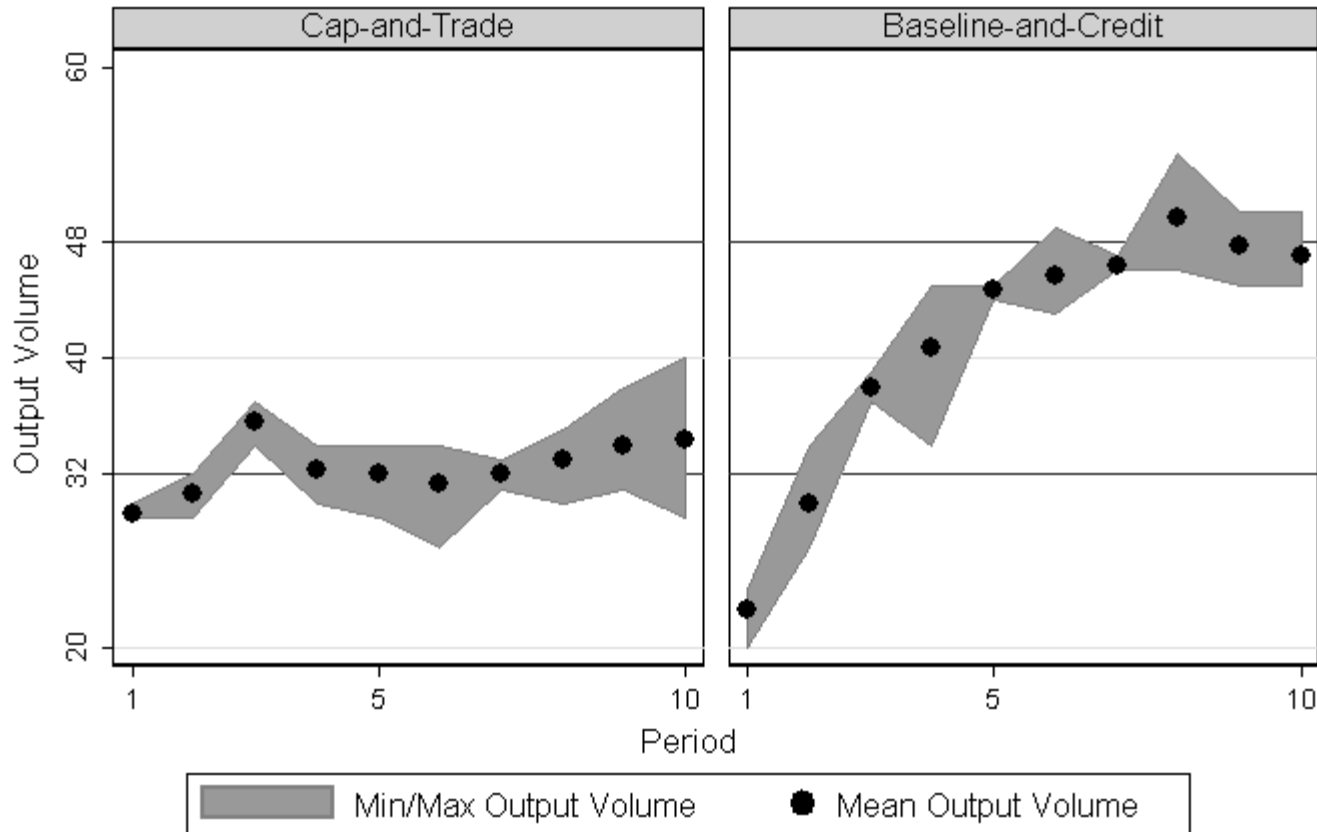
Second Experiment:

Does the capacity mechanism work?



Variable Capacity, Fixed Intensity

As predicted
Output Expands Rapidly under B&C

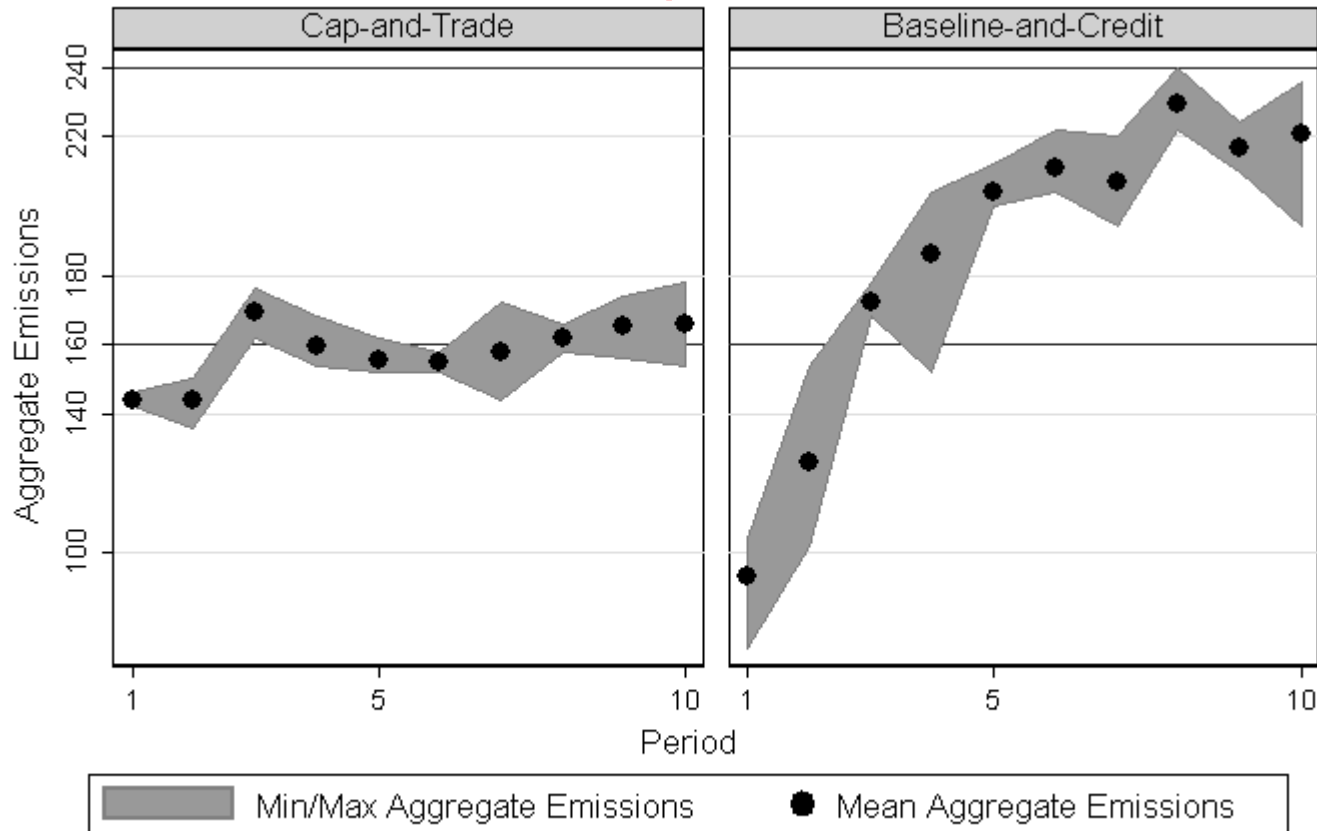


Graphs by Emission Trading Mechanism



Variable Capacity, Fixed Intensity

As predicted
Emissions Expand under B&C

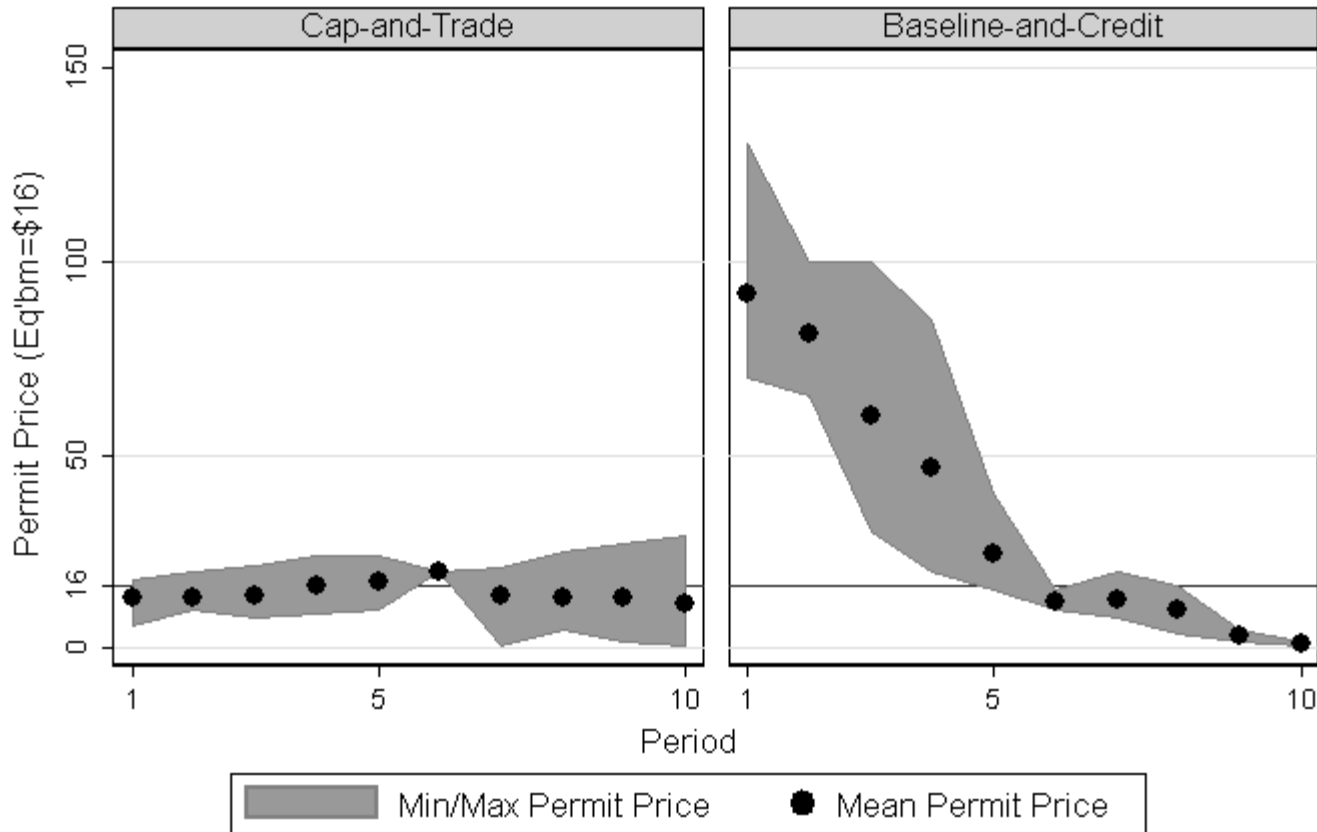


Graphs by Emission Trading Mechanism



Variable Capacity, Fixed Intensity

Permit Prices behave differently

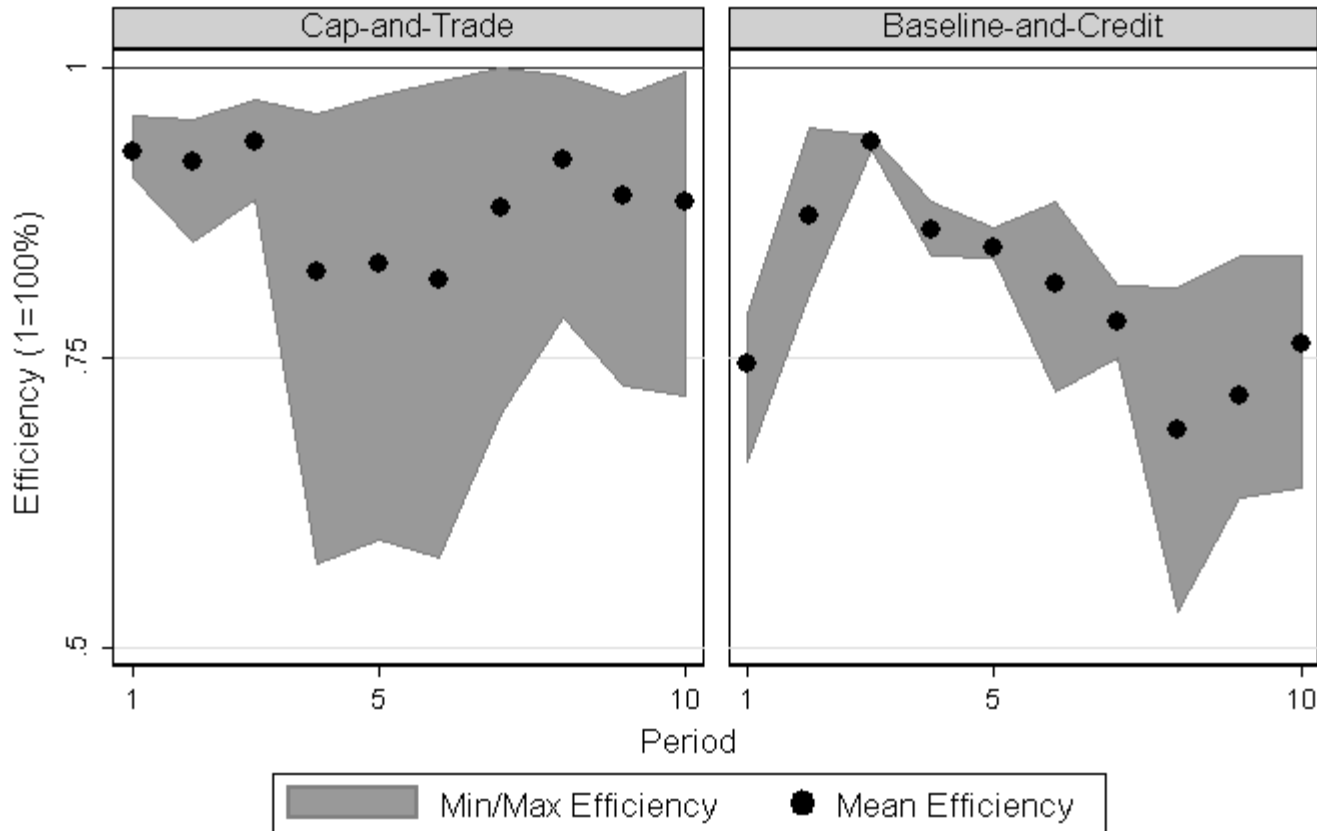


Graphs by Emission Trading Mechanism



Variable Capacity, Fixed Intensity

Efficiency declines under B&C



Graphs by Emission Trading Mechanism



Variable Intensity and Capacity

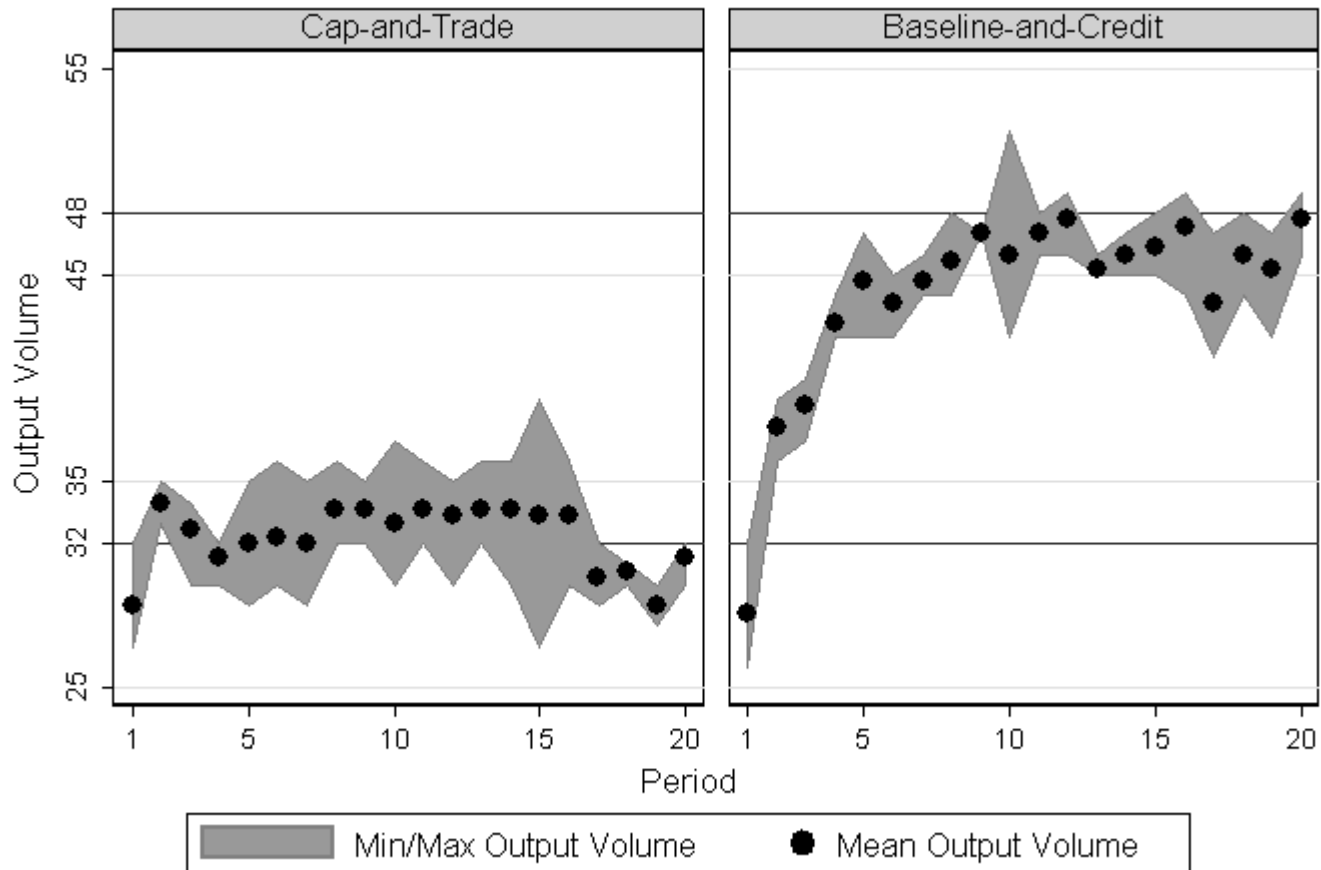
Experiment Three:

Do the predictions hold when both capacity and intensity are variable?



Variable Intensity and Capacity

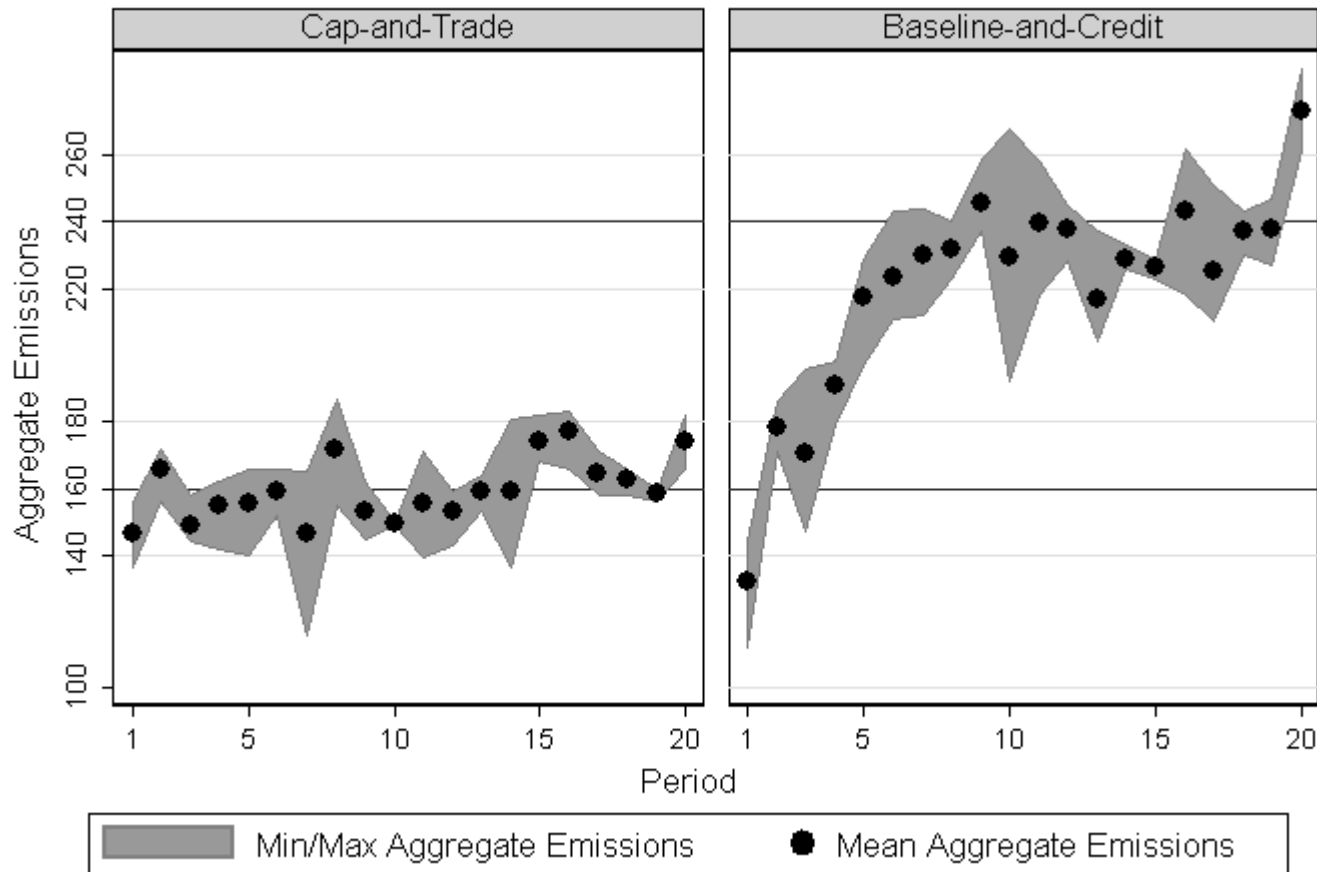
B&C output expands as predicted





Variable Intensity and Capacity

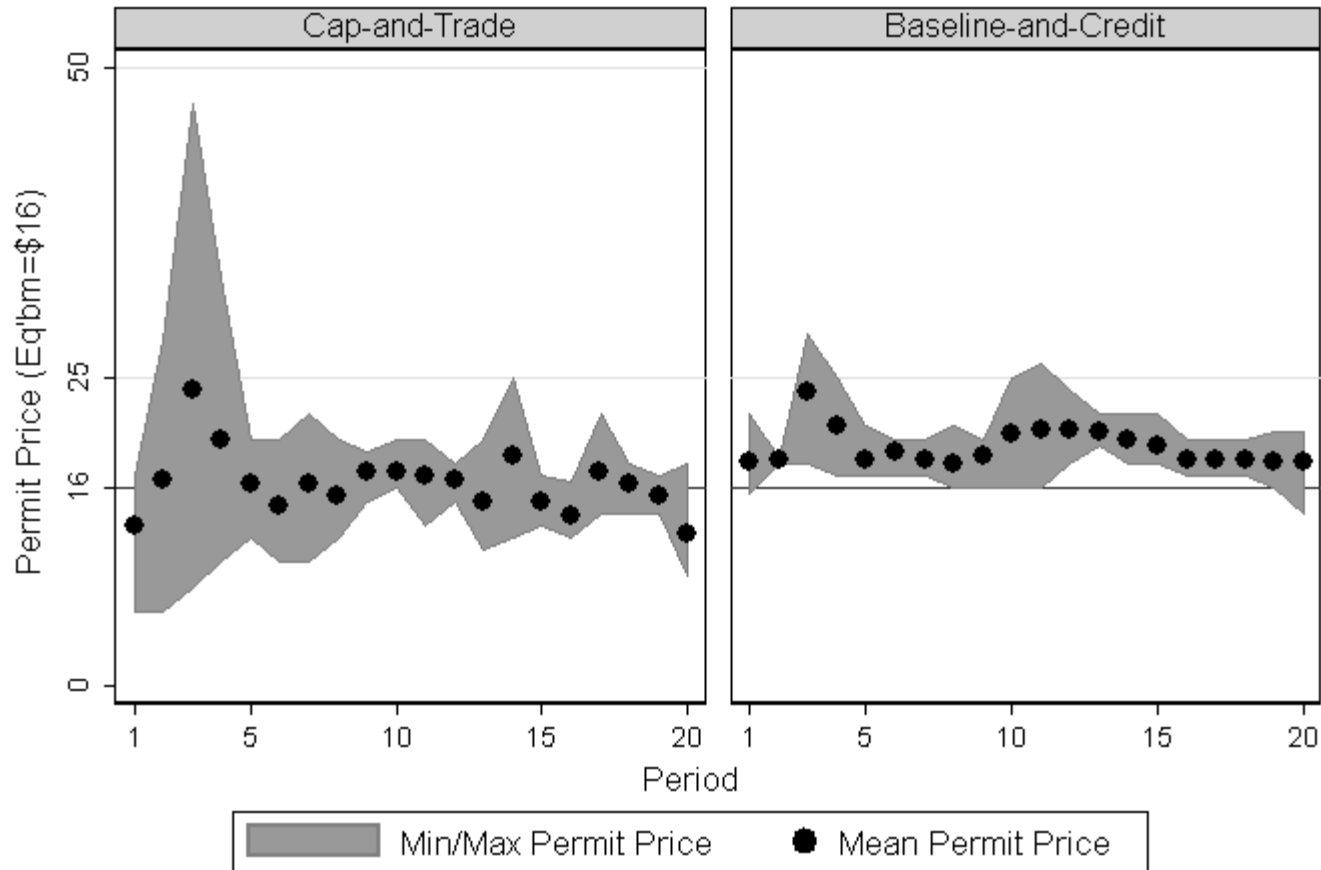
Emissions expand as predicted





Variable Intensity and Capacity

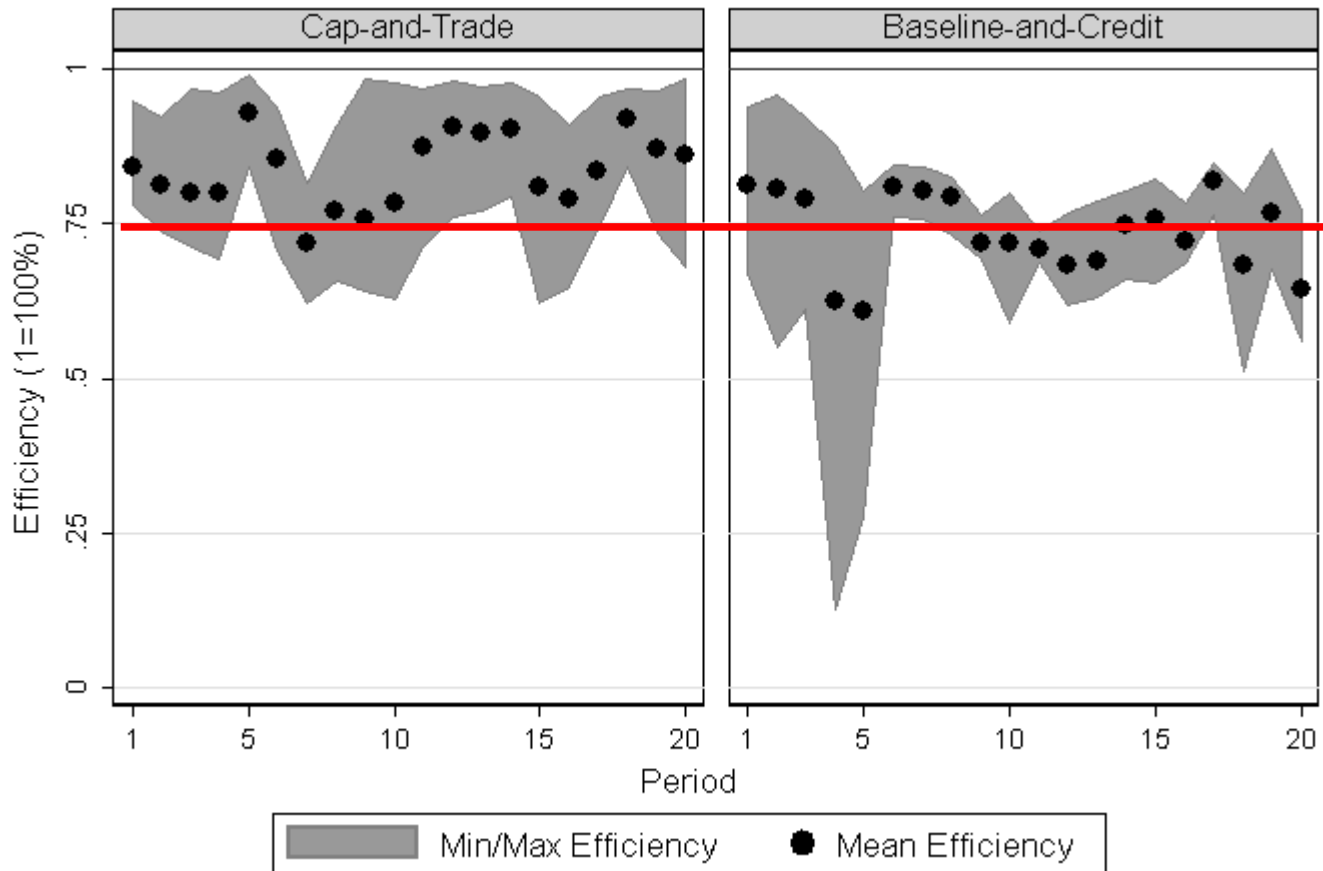
Permit Prices close to predictions





Variable Intensity and Capacity

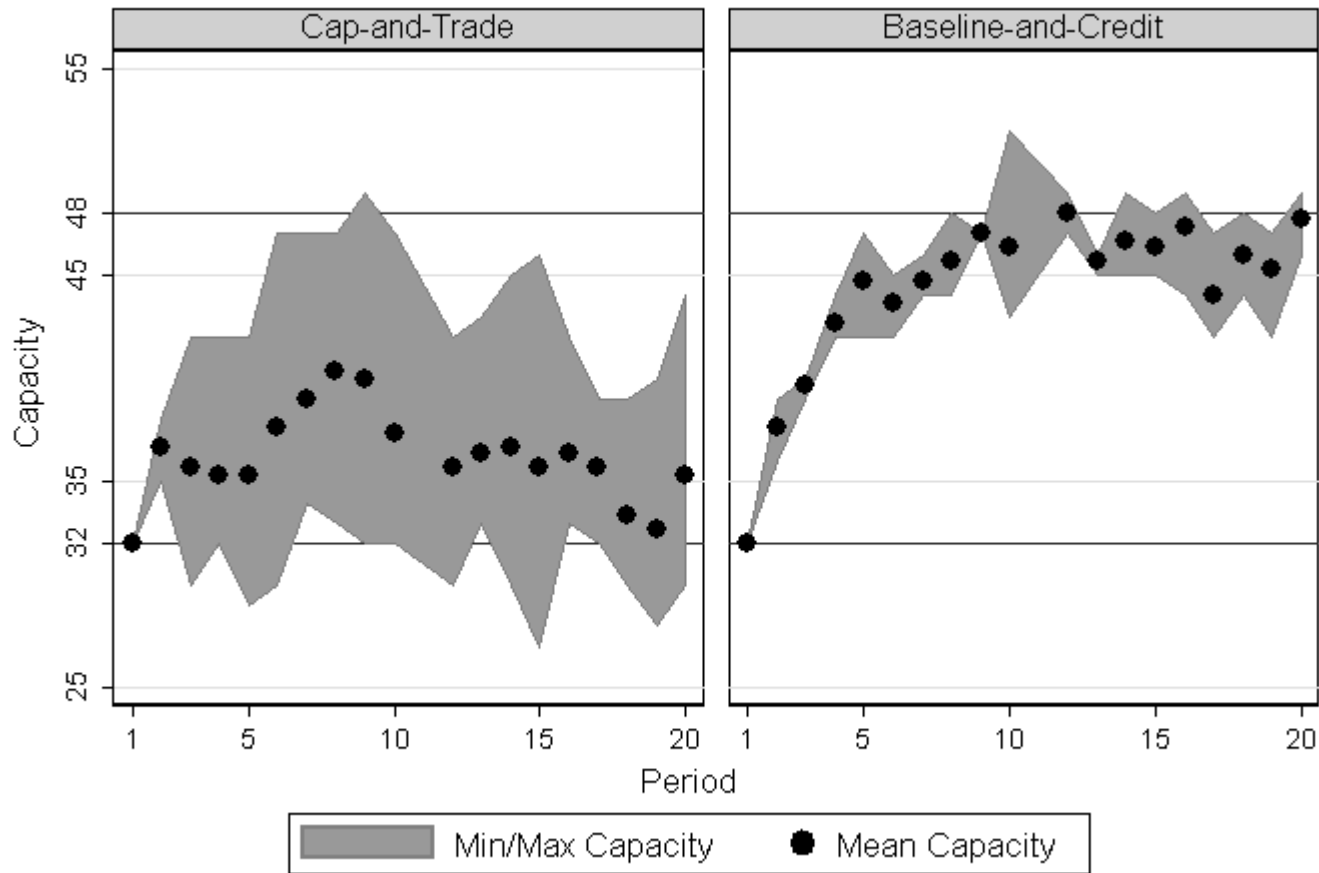
Efficiency lower in B&C





Variable Intensity and Capacity

Persistent over-capacity in C&T





Conclusions

**Laboratory experiments
are a powerful tool
for demonstrating a serious flaw
in emissions trading with
baselines linked to output.**



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